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NARRAGANSETT MARINE LABORATORY

of the

UNIVERSITY OF RHODE ISLAND

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NARRAGANSETT MARINE LABORATORY

University of Rhode Island

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OCEANIC BIOLOGY PROJECT

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ABSTRACT

Field and laboratory work completed so far during the current year prior to 14 November includes 619 sounds analyzed, 57 charts prepared and 49 disc recordings made from data obtained on the fish faunas of Narragansett Bay and Bermuda. During the period 17 November to 31 December 349 individual sound experiments, of which 243 were positive, were performed on 73 species of fishes, 12 species of crustacea, six specimens of Florida porpoise, and two specimens of sea lion. Sound experiments were also made on more than 80 specimens of invertebrates representing six different taxonomic groups of crustacea of which all but two were generally sonic. A method of studying sound production in fishes by synchronizing motion picture and sound records of the animal in the act of noise making was developed while at the Lerner Marine Laboratory. Ambient noise recordings were made in different localities and at different times in the Bimini area. In all 115,200 feet of magnetic tape recordings and 900 feet of motion picture records were obtained. Anatomical dissections were completed on 116 specimens representing 51 species of fishes. Zooplankton studies on two annual cycles of weekly collections and data from weather station EASY in the central Atlantic were begun by three investigators in September. Three technical reports have been issued in published form during the past quarter.

THE OCEANIC BIOLOGY PROJECT

RESEARCH

1. Sonic Fish Program. The first of three publications on underwater sound production by North Atlantic coastal fishes appeared in December in the Journal of Marine Research, Volume XI, No. 2, 1952 pp.180-193. This paper which is being distributed as Technical Report No. 1 is confined largely to physical and ecological data on twenty-six species. A more comprehensive analysis of both physical and biological aspects of the subject with sound curves for each species is now being readied for publication. The galley proof of a third technical report, "The Production of Underwater Sound by the Seahorse, Hippocampus hudsonius" by Marie P. Fish has been returned for publication in Copeia, the Journal of the American Society of Ichthyologists and Herpetologists.

A summary of field and laboratory work completed to date in the current year includes:

Narragansett Bay fauna: 201 winter sculpin sounds analyzed and 24 charts and 22 disc recordings prepared.

Bermuda fauna: 117 individual sound experiments performed of which 92 were positive; 418 sounds from 19 species were analyzed with an octave filter, 33 frequency spectra charts prepared and 27 disc recordings added to the reference file.

Bahama (Bimini) fauna: 349 individual sound experiments, of which 243 were positive, were performed on 73 species of fishes, twelve species of crustacea, six specimens of Florida porpoise and two specimens of sea lion. In all 115,200 feet (22 miles) of magnetic tape recordings are available for analysis and further study. Twenty species of positive sound producing fishes and one species of spiny lobster were subjected to combined photo and tape recorder study. More than 900 feet of motion picture records were obtained. Anatomical dissections, with measurements and essential sound producing mechanisms preserved for further study, were completed on 116 specimens representing 51 species of fishes.

Invertebrate animals tank tested at Bimini during this period included: 30 specimens of snapping shrimp representing 6 species, 12 specimens of spiny lobster (Panulirus argus), 13 specimens of Squilla (Gonodactylus sp.), two specimens of Hippa, and 5 species of crabs. Of these, snapping shrimps, Squilla and spiny lobsters were generally sonic, but of the crabs only calappa could be induced to produce detectable sound.

An unusual opportunity was afforded to observe and record the bottle-nose porpoise, Turciops truncatus, under varying conditions. Sound recordings were made of two large specimens under normal conditions in an enclosure where they had lived for several years. Subsequent observations recorded the activity and sounds of one of these after the other had died. Autopsies of both specimens made possible measurements and study of sound mechanisms, not previously synchronized with specific

porpoise sound recordings. In addition, three wild porpoises, two adult females and a nursing baby, were recorded immediately after capture, throughout their first few days of captivity, and after taming. Again their soundmaking was recorded following the death of the young porpoise. These studies provided valuable data on the variety of sounds produced by this species and their significance.

The field party, consisting of Charles J. Fish, Marie P. Fish and William H. Mowbray based at the Lerner Marine Laboratory from 17 November to 22 December then transferred across the Florida Straits and continued investigations in Ismoralda. Here natural background noises were recorded and special studies made on captive porpoises and sea lions. In the latter, the tests were designed to determine the distance at which sounds (barks) produced at and immediately above the surface can be detected by the hydrophone. The field party terminated work in Florida on 31 December.

The Narragansett Marine Laboratory wishes to express its appreciation to the American Museum of Natural History for the excellent facilities afforded, and to Dr. Michael Lerner, Mr. Marshall Bishop, and all resident Laboratory personnel for constant, valuable cooperation.

Developments during the current year have resulted in a better understanding of the nature and occurrence of sound production by marine animals. Among these may be listed:

1. Sound production in marine fishes has been found to be far more general than originally suspected from anatomical evidence. It is now obvious that every fish must now be considered a potential sound producer until proven otherwise.

2. It has also become increasingly evident that general ambient noise recordings give no accurate indication of the fish sounds to be expected in any particular area. It is true that certain species, such as the sea robin and other gregarious species, appear to produce sounds repeatedly and without any apparent stimulation. The croaker is particularly noisy at dawn and dusk during its migration to the spawning grounds, and the toad fish similarly makes noises more or less continuously during its spawning season. However, the greater percentage of the fish population, although capable of producing sounds, does so only in response to definite stimuli. Repeated listening and recording in Bahama reef areas populated by a wide variety of known sound producers yielded no fish noises, although during one listening period a school of more than 1000 grunts, notorious sound producers, passed within a few feet of the microphone, and shortly thereafter several other sonic forms, including tang, darted about noiselessly. Therefore, since sonic species can be expected to produce sound under certain conditions, the only way that one can determine what noises of biological origin may be expected in any particular area is to test experimentally the individual species comprising the fauna and assume that any one of these may produce sound. The technique developed in the Oceanic Biology Project would, therefore, appear to provide a rather essential approach

to this problem, and to meet Navy needs it is recommended that the character of the sound to be expected in other faunal areas be determined in a similar manner as a supplement to general ambient sound measurements.

3. Unlike fish noises, crustacean sounds were found to occur continuously in Bahama and Florida Key coastal waters, although they are apparently of somewhat greater volume in the late afternoon and evening than in the morning. It is also apparent that whereas crustacean noises in sub-tropic and tropic waters have generally been attributed to snapping shrimps of the Alphaeus and Synalphaeus type, in the Bahamas at least small species of squilla of the Gonodactylus type are almost equal if not equal in importance. The sounds produced by all of these animals are almost indistinguishable to the human ear.

4. Evidence obtained at the Bimini Laboratory indicates that sounds of the type produced by shallow water species of grouper (Epinephalus) occur to depths of at least 400 meters. Two species, E. mystacinus and an as yet unidentified golden grouper of the genus Epinephalus, both from depths ranging from 300 to 400 meters, were found to have almost identical sound producing mechanisms. In fact, the deep water species had relatively larger swim bladders than those of the shallow areas. It was not possible to make sound recordings, even though specimens of both species were alive when they reached the surface, because pressure changes had caused the swim bladders to be forced past the pharyngeal into the buccal cavity. The fishes on which these observations were made were taken in connection with blood analyses being carried on by another group of workers. These individuals informed us that in work carried on during a previous year at depths ranging from 200 to 250 meters, groupers were recovered with the swim bladder in situ and these frequently were heard to produce sounds as they approached the surface. In view of the controversial information on sounds attributable to animals in deep water, this evidence that those of the grouper type occur at least to 400 meter depths is considered significant.

An important new development during the past quarter has been the perfection of a method of studying the mechanism of sound production in fishes by synchronizing a motion picture record with the sound record of each species as it produces sounds. This permits a study of the exact movements of the fish while making the sound and the external body parts involved. It is believed that in some species the motions of the fish during this period may also indicate the significance of the action. The technique of combining motion picture and tape recorder records is being adopted as standard laboratory experimental procedure.

2. Open Ocean Plankton Program. Work on the two annual cycles of weekly collections and data from weather station EASY (35°00'N, 48°00'W) in the central Atlantic has been in progress since September 1952. Analysis of quantitative zooplankton samples and correlation with physical environmental factors during the first year (16 February 1950 - 20 February 1951) are being done by Theodore Napora. Mr. Robert Campbell is making comparable studies on material taken during the second year (27 February 1951 - 25 February 1952).

Joseph Graham is also analyzing the night surface samples taken weekly during the two years with half-meter (No. 2 silk) nets at station EASY. These will be compared with similar night surface hauls and also vertical series of closing net hauls day and night to be obtained at a GILL station in another central Atlantic locality. One objective will be to determine what percentage of the surface population during the hours of darkness at the station EASY represents migrants from the Transition Zone. Should the Transition Zone faunas in the two areas be found comparable the annual cycle of the Transition Zone migrants at the GILL station can be deduced from the weather station data.

In November three Clarke-Bumpus samplers fitted with closing devices were supplied to Dr. Sidney Galler for preliminary collections, from which to determine closing net depth ranges for use when the Transition Zone field program begins in mid-winter (February). As conditions in this zone are far more uniform than in the layers above it is believed that observations not more than twice a year (mid-summer and mid-winter) will suffice. However, on these occasions an extensive series of collections with closing nets at all levels between 1000 meters and the surface, throughout a 24 hour cycle, will be necessary to determine diurnal movements of the population. Correlated with the collections will be fathometer readings to indicate the depths of animal concentrations (scattering layers) at the times of hauling.

3. Publications and Reports. In addition to Technical Report No. 1, previously mentioned, the following have appeared in published form during the past quarter.

Technical Report No. 2. The Herring (Clupea harengus) of Block Island Sound. Howard L. Sanders, Bull. Bingham Oceanographic Collection. Vol. XIII, No. 3, pp. 220-237, 1952.

Technical Report No. 3. The Biology of the Surface Zone Zooplankton of a Boreo-Arctic Atlantic Ocean Area. William V. Kielhorn. Jour. Fisheries Research Board of Canada. Vol. IX, No. 5, pp. 223-264, 1952.

PERSONNEL

4.

Name	Title
Charles J. Fish	Senior Biological Oceanographer (quarter time)
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Joseph Graham	Associate Biological Oceanographer
William H. Mowbray	Electronics Technician
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